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ABSTRACT

The purpose of this study was to (1) compare the semantic relationships among common nouns obtained via two different measurement procedures and (2) determine if the use of these relationships to classify the various words results in differential degrees of learning when the stimuli are cast in terms of the paired-associate learning paradigm. Three sample groups of 120, 60, and 320 consisted of volunteer undergraduate students. Results of the analyses showed that (1) Although the number of salient, semantic dimensions derived when scaling the stimuli via the semantic differential and multidimensional scaling procedures were basically the same, the specific interrelationships exhibited among the stimuli under the two procedures were quite different; and (2) When the nouns were used in a paired-associate learning task which incorporated both sets of relationships, significantly different levels of learning were observed. These results suggest that in learning situations such as this, the use of a multidimensional scaling algorithm may represent a more efficient procedure than the semantic differential for specifying the semantic interrelationships among small sets of verbal stimuli. (Author/JF)

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AN ANALYSIS OF THE SEMANTIC RELATIONSHIPS AMONG WORDS AND THEIR EFFECT UPON LEARNING

James M. Weber

The Pennsylvania State University
University Park, Pennsylvania 16802

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
National Center for Educational Research and Development
(Regional Research Program)

Abstract

Title of Project: An Analysis of the Semantic Relationships Among Words and Their Effect Upon Learning

Principal Investigator: James M. Weber

Contracting Agency: The Pennsylvania State University

When certain of the problems associated with the instructional process are perceived in terms of communications theory, it is quite evident that a major problem facing educators is the measurement and evaluation of the semantic dimensions of message content. The purposes of the present study were to compare the semantic relationships among common nouns obtained via two different measurement procedures, and then, to determine if the use of these relationships to classify the various words resulted in differential degrees of learning when the stimuli were cast in terms of the paired-associate learning paradigm.

~~The resultant~~ analyses showed that (a) although the number of salient, semantic dimensions derived when scaling the stimuli via the semantic differential and multidimensional scaling procedures were basically the same, the specific interrelationships exhibited among the stimuli under the two procedures were quite different, and (b), when the nouns were used in a PA learning task which incorporated both sets of relationships, significantly different levels of learning were observed. These results suggest that in learning situations such as the one considered the use of a multidimensional scaling algorithm may represent a more efficient procedure than the semantic differential for specifying the semantic interrelationships among small sets of verbal stimuli.

Introduction

The Problem

When instruction is viewed as possessing many of the characteristics of the communications process it becomes evident that a major problem facing educators is understanding the specific effects of different message characteristics and organizations upon the learner. In particular, since the majority of such messages are comprised largely of verbal elements, an important subproblem within this more general area of concern is understanding how students perceive such verbal elements as well as how these perceptions can be used to advantage in structuring messages to be employed in an instructional context. This subproblem basically involves the delineation of both the semantic and syntactic components of message content.

The present investigation focused upon the former of these two components. Specifically, it dealt (a) with comparing several techniques for measuring students' semantic conceptions relative to a set of common nouns, and (b) with evaluating the importance of the interrelationships derived via these procedures to rate of learning, when the messages of interest contained only two basic, content elements.

Related Research

In order to better understand the implications and effects of different message elements upon a learner, it has been necessary for psychologists and linguists to engage in the measurement and evaluation of the semantic dimensions which learners use to characterize such elements. This concern has led to numerous theoretical, as well as operational, conceptions of what constitutes the "meaning" of a particular stimulis.

With regard to words commonly used in the English language, the measurement of meaning has progressed from the development of familiarity estimates based upon frequency counts (Large and Thorndike, 1944) to the attempted determination of the dimensionality of an individual's connotative, semantic space via the semantic differential (Osgood, et al., 1957). More recently interested researchers have been employing various analytic techniques in an attempt to determine the most salient characteristics of word meaning as assessed via the different indices that have been developed.

Paivio (1968), for example, factor analyzed a combination of 30 different indicants of both learning and word meaning in an attempt to isolate the major dimensions present in his selected set of measures, and relate them to the verbal learning process. The six major factors to evolve were (a) concreteness-imagery, (b) impressiveness-complexity-emotionality, (c) familiarity-frequency, (d) specificity-preciseness, (e) associative variety, and (f) a learning, or ease of learning factor. This investigation, as well as others, suggest that word meaning is a complex, multi-faceted construct, which can serve as a powerful variable in the learning process (DeCecco, 1967; Staats, 1968).

A major shortcoming of such studies has been the fact that most of the individual measurement procedures they have considered usually fail to adequately represent the multidimensional character of word meaning as perceived by the learner. In particular, the indices frequently used have had one or both of the following limitations in common: (a) they have been specifically designed to generate undimensional scales which result in the alignment of stimuli along a single continuum, thereby

eliminating the possibility of a multidimensional construct emerging, and/or (b) they have involved procedures structured in such a manner that the post-analytic, semantic dimensions obtained may be confounded by the investigator's selection of scalar exemplars. The first of these problems is evident in the development of association norms which permit the respondents to make but one response to each stimulus, while the second can occur because of an experimenter's reliance upon a limited range of bi-polar adjectives when employing the semantic differential. The net effect of these limitations is that the procedures either directly or indirectly force the respondents to evaluate the stimuli selected for study in terms of an externally determined set of semantic dimensions, which may or may not be analagous to their implicit semantic schemes.

A somewhat different methodological strategy for determining semantic structure is currently available in the form of multidimensional scaling. This approach circumvents the limitations noted above, since the respondents are not instructed to make their responses with regard to a particular dimension or set of structured scales. Instead, they are asked to respond only in terms of perceived similarities and/or differences among the stimuli being considered. Although this strategy can only be employed when dealing with a specified subset of verbal stimuli (common English nouns), it is conceivable that its application to the generation of relationships among the selected stimuli will better reflect the salient characteristics of the respondents' implicit semantic schemes than will other, commonly used techniques.

The initial phase of the present investigation, therefore, was directed toward assessing the feasibility of employing such a multidimensional scaling procedure to define the semantic relationships among a set

of verbal stimuli. The specific objectives were (a) to evaluate the dimensionality and semantic relationships existent among a selected set of common nouns for a sample of college students using Kruskal's multidimensional scaling algorithm (1964), and (b) to compare the results obtained via this multidimensional scaling technique with those obtained using a modified form of the semantic differential, i.e., modified in the sense of employing a more heterogeneous set of bi-polar adjectives than is frequently used.

The last part of the study was concerned with utilizing the results of the first phase to define relationships between the major components of selected, simple messages that contained only two content elements. Such a practice is in accord with the basic procedure used by psychologists to further our understanding of the learning process. Specifically, the derived relationships were used to generate several sets of learning materials to be employed in making inferences regarding the activities utilized by learners in assimilating those materials.

This same general procedure was utilized by Rohwer (1967), who in a series of systematic empirical investigations, has shown that embedding paired-associates (paired message elements) in semantically and syntactically structured verbal strings results in increased learning efficiency. The basic types of message sets he employed were as follows:

(a) the Standard Paired-Associate Paradigm

noun (stimulus) - <u>noun (response)</u>;

(b) the Verbal-String Paradigm

adjective-noun (stimulus) - connective-adjective-<u>noun (response)</u>.

In addition to the "elaboration" effects noted above, Rohwer has also shown

that the use of different form-classes of connectives in the verbal-string paradigm (e.g., conjunctions, prepositions, and verbs) differentially affects learners' rates of acquisition.

These empirical findings have been assimilated in terms of the representational mediation model (Osgood, et al., 1957), and the resultant rationale (Weber, 1968) suggests:

(a) If the critical nouns (elements) are presented contiguously the mere contiguity of association will cause the common mediating reaction characterizing the two elements in interaction to eventually replace the mediating reactions characteristic of each element in isolation.

(b) If the critical elements are presented in the context of semantically and syntactically structured strings during the input phase of the learning task, then the rate at which the interactive, mediating reaction comes to replace the reactions of each in isolation will be related to the form-class of the connectives employed in the verbal strings.

(c) If the critical elements are similar in "meaning" following the input phase of the learning process, the degree of similarity will be reflected in the rate of acquisition of the respective response elements as measured by test trial performance.

(d) If connectives in verbal strings help to accelerate the rate at which the interactive, mediating reaction replaces the reactions to the elements in isolation, then the effects of connectives will be differentially affected by the nature of the learner's prior mediating reactions to the elements in isolation.

The specific hypotheses derived from these theoretical suppositions and tested in the second phase of the present study were:

(a) Word pairs in which both elements are perceived by a sample of respondents as being relatively distant from the origin of the derived semantic space will be more readily learned than word pairs in which the elements are close to the origin of the space.

(b) Word pairs in which the stimulus and response elements are viewed as being semantically similar by the respondents will be learned more rapidly than word pairs in which the elements are viewed as being dissimilar.

(c) If the word pairs of interest are embedded in verbal strings with verb connectives for one group of subjects and presented in the standard paired-associate format for another group of subjects, on interaction between similarity of intra-word pair meaning and such a grouping will be observed.

Procedure

Design and Materials

During the semantic description phase of the investigation a set of 60 common nouns were randomly selected from a general list prepared by Osgood (1964). These nouns served as the verbal elements considered in both phases of the study. One sample of 120 college students scaled these stimuli using the method of multidimensional rank order (Nunnally, 1967; Torgerson, 1958), while a second sample of 60 students rated them on a modified form of the semantic differential. These two groups of respondents were selected via a systematic sampling procedure.

Under both measurement procedures a sampling of stimuli similar to that suggested by Carroll (1959) was used. Specifically, the students assigned to the ranking task were required to rank order 59 stimuli in terms of their similarity to each of 15 randomly selected words. Thus, for each such respondent the resultant data consisted of 15 rank orderings within each of which 59 of the nouns were ranked in terms of their similarity to a randomly designated noun. The composite set of data, which consisted of 30 rank orderings for each stimulus, were then cast in terms of a 60 x 60 similarity matrix, i.e., the average of the ranks assigned to each stimulus served as the columns of a similarity matrix. This matrix was then evaluated using Kruskal's nonmetric, multidimensional scaling technique to determine the dimensionality, scale values, and distances among the stimuli for the selected respondents (Krushal, 1964).

The particular form of the semantic differential administered to the second sample of students contained 21 scales or sets of bi-polar adjectives. Three of these scales were related to each of the three factors noted by Osgood, et al. (1957), i.e., the evaluative, potency, and activity factors, while the remaining 12 scales were equally divided among four of the factors identified by Pavio (1968), i.e., the concreteness, complexity, familiarity, and specificity factors. The arrangement of words and scales paralleled that outlined by Osgood, et al. (1957). Hence, the data obtained from each respondent using this procedure consisted of ratings on 21 scales for each of 30 randomly selected stimuli. The composite data for each stimulus object (approximately 30 sets of ratings) were submitted to a correlational analysis, and sixty 21x21 correlation matrices were generated. These sixty matrices were then

pooled, and the resultant composite, factor analyzed to obtain an estimate of the dimensionality of the semantic space for the second set of subjects. Factor scores for the 60 nouns were also obtained and used to calculate distance estimates among the stimuli. (The specific instructions and sample pages from the ranking and rating booklets used are contained in Appendices A and B, respectively.)

Following the derivation of the two semantic structures comparative analyses were undertaken. First, since the two spaces generated were euclidean in form, polarity estimates for the stimuli (i.e., estimates of their distances from the origins of the derived spaces - an index of their "meaningfulness" (Osgood, et al. 1957)) could be computed and compared. The resultant hypothesis was viewed as a test of the similarity of polarity estimates evolving from the two procedures. If this hypothesis was not rejected, an hypothesis, formulated in terms of a X^2 test, and directed toward assessing the similarity of the inter-point distances generated via the two approaches, was to be evaluated. Finally, the sets of scale values (factor scores in the case of the semantic differential) were submitted to a cluster analysis (Overall and Klett, 1972) to determine if the clusters of words generated using the two procedures were similar.

Following these comparisons, the polarity estimates developed were used to divide the set of stimuli into two groups - a low polarity and a high polarity group. Both sets of polarity estimates were used, so there were now four groups of words - ranking, high and low polarity; rating, high and low polarity. Then, the scale values for the different stimuli were used to compute intra-word pair distances (or estimates of similarity of meaning) between the different word pairs within each of the polarity subgroups. Hence, for both the ranking and rating techniques

four different subsets of paired-associates were developed - low polarity, small intra-word pair distance; low polarity, large distance; high polarity, small distance; and high polarity, large distance. In the learning phase of the study the two sources of these different classifications of word pairs served as an independent variable, while cumulative responses to the different subsets during testing served as the multiple dependent variables.

In order to incorporate the third hypothesis into the study a second independent variable was developed and crossed with the previous one. Specifically, for each of the levels of the initial variable two sets of materials were developed. In one set the standard paired-associate paradigm was used, while in the other each of the word pairs was embedded in a verbal string containing a verb connective. Finally, two blocking variables, one involving list variations (2 levels) and the other involving order of presentation (2 levels), were added.

During the learning phases of the study each student was randomly assigned to one of the 16 cells generated via the preceding design. Under each of these conditions the students were presented a total of 20 paired-associates, 5 from each of the subgroups noted above. A 3:3-second rate of presentation with a 6-second inter-trail interval was used during each of two trails. Cumulative correct responses over these two trials for each of the four subgroups of word pairs served as the data for the second phase. (The set of instructions used to explain the learning task, as well as the accompanying examples, can be found in Appendix C.)

<u>Subjects</u>

The population of subjects for the study consisted of the undergrad-

uate students enrolled in a basic educational psychology course. Although most of these students were education majors, they did represent a heterogeneous mixture of individuals from differing socio-cultural and educational backgrounds. The three samples consisted of 120, 60, and 320 volunteers, respectively, from this population.

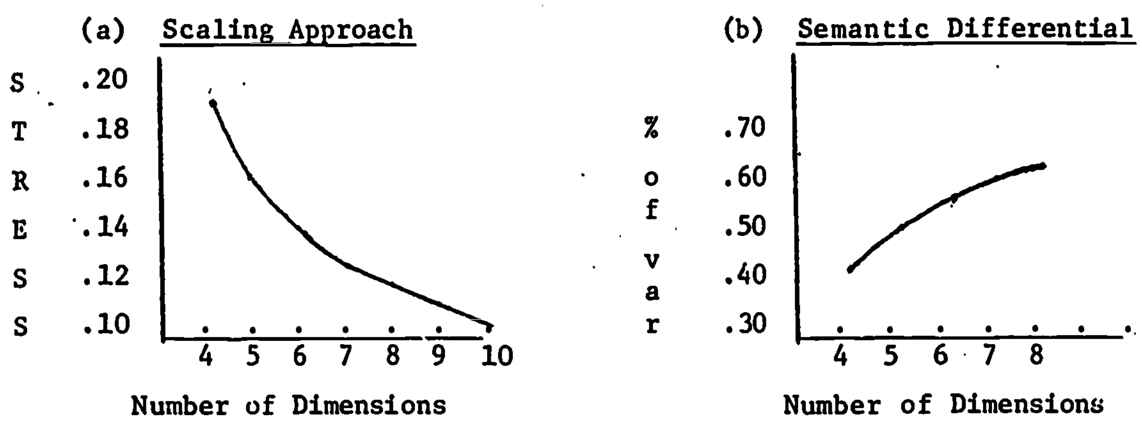
Results

Semantic Description Phase

Since the major purpose of this initial phase of the investigation was to compare the semantic structures obtained via the multidimensional scaling and semantic differential procedures, the first analysis that were undertaken represented the attempts to assess the dimensionalities of the spaces generated under the two approaches. The results of these analyses are summarized in Figure 1, which illustrates the relationship between the number of dimensions considered and the respective, goodness-of-fit indices.

Figure 1

The Relationship Between Dimensionality and Goodness-of-Fit Indices



As indicated in Figure 1 the goodness-of-fit index employed with Kruskal's multidimensional scaling algorithm is stress. Specifically, the lower the stress value one obtains the better the fit of the derived space to the full space spanned by all the stimuli, with the ideal being a stress of zero. In applications of this criterion Kruskal (1964) suggests that the dimensionality of the derived space be designated by that abscissa where the stress curve begins to stop accelerating. Hence, in the present case the dimensionality of the derived semantic space using the scaling procedure was set at 7.

In the case of the factor analysis involving the intercorrelations among the 21 scales used on the Semantic Differential, the dimensionality of the derived space was also set at 7. This decision was arrived at via the general role suggested by Kaiser (1958). Specifically, he has suggested that factoring cease when the last eigenvalue extracted becomes less than 1. In the present instance the eigenvalue associated with the 7th factor was equal to .92. Although this procedure is not infallible, the representation presented in Figure 1 shows that at an abscessa value of 7 the curve for percentage of variance accounted for begins to stop accelerating much like the stress curve presented in the first part of the Figure. (The rotated factor matrix for the seven factors can be found in Appendix D.)

The hypothesis concerning the similarity of polarity estimates generated via the two procedures was tested using the one-sample Wilcosan statistic. The results of this test are presented in Table 1. (See next page.) When computing this test statistic the actual polarity estimates were replaced by their respective within method ranks and the resultant ranks compared, because of the inherent variations in the

Table 1

The Evaluation of Similarities in the Polarity Estimates

N	Sum of Negative Ranks	1-Value	p
59	656.5	1.90	.06

magnitudes of the orginal polarity estimates. (The original polarity estimates are contained in Appendix E.) As seen in Table 1, the resultant analysis did not lead to a rejection of the hypothesis of similarity in polarity estimation using the two techinques. Since the value of the observed test statistic was so close to the critical value needed for rejection, an additional analysis was undertaken. In this analysis (Summarized in Table 2.) the stimuli were broken into high and low polarity subgroups for both scaling approaches, and the resultant data compared in terms of a contingency table.

Table 2

A Comparison of the Polarity Estimates Generated Via the Two Techniques

		Semantic Differential High Pol.	Low Pol.	X^2-Value	p
Rankings	High Polarity	16	14	13.06	.001
	Low Polarity	14	16		

Due to the results evolving from the two preceding analyses it was concluded that the classification of the set of words into high and low polarity subsets using the two procedures was not the same, i.e., the

two procedures lead to different classifications for the stimuli. Since any comparisons among the inter-point distances generated under the techniques was dependent upon the existence of comparable classifications in terms of polarity levels, the evaluation of the second hypothesis described in the previous section was not undertaken.

Although the second hypothesis was omitted, the cluster analyses were generated, using interstimulus distances to identify subgroups of stimuli (See Overall, J.E. and Klett, C.J., 1972). The results of these analyses are contained in Tables 3 and 4.

Table 3

The Clusters Evolving From the Analysis of the Semantic Differential factor scores

Cluster #1	Cluster #2	Cluster #3	Cluster #4	Cluster #5
respect	rain	smoke	dog	death
woman	hair	pain	heart	hunger
lake	stone	crime	doctor	
story	bread	power	tongue	
hope	egg	fire	horse	
color	wednesday	thief	man	
freedom	heat	policeman	girl	
future	fruit	guilt	work	
friend	chair	fear	cat	
sun	window	hunger	river	
knowledge	smoke			
sympathy	cap			
head				
need				
star				
picture				
choice				
relief				
peace				
music				
progress				
marriage				

Cluster #6	Cluster #7	Cluster #8
house	wealth	laughter
wednesday	choice	river
map	courage	

Table 4

The Clusters Evolving From the Analysis of the Scale Scores

Cluster #1	Cluster #2	Cluster #3	Cluster #4	Cluster #5
hair	rain	smoke	pain	respect
woman	stone	dog	crime	hope
heart	lake	tongue	fire	freedom
friend	mop	horse	thief	future
man	river	cat	death	knowledge
head			policeman	need
girl			guilt	choice
laughter			fear	power
marriage			smoke	relief
				peace
				courage
				progress

Cluster #6	Cluster #7	Cluster #8	Cluster #9	Cluster #10
bread	color	wealth	doctor	story
egg	sun	house	sympathy	picture
fruit	heat	chair	death	music
hunger	star	work		
cup	picture			
	window			

The most obvious differences between the results of the two cluster analyses is the numbers of multi-stimulus clusters generated. Specifically, the analysis of the factor scores produced via the semantic differential procedure yielded eight clusters, while the analysis of the scale scores yielded ten clusters. Also, with the semantic differential scores a major cluster with a number of minor clusters was evidenced, but with the scale scores the clusters were somewhat more homogeneous in size. Finally, visual inspection of the two sets of clusters suggests that those clusters evolving from the analysis of the scale scores are more homogeneous in

meaning and more easily describable than those evolving from the analysis of the semantic differential, factor scores.

Learning Phase

As indicated in the design section, in this phase of the study the procedure for generating mixed, paired-associate lists described by Weber (1968) was employed. Following this procedure, four distinct lists of paired-associates were developed. The results contained in Table 5 show that these various lists contained the desired characteristics. Namely, the distances among the four subgroups of intra-list pairs could be ordered as follows: low polarity-small distances $\cong$ high polarity-small distances < low polarity-large distances < high polarity-large distances.

Table 5

Comparisons Among the Intra-List Subgroups of PA's

Source	List #	Average Ranks of Subgroups L.R-S.D.	L.P.-L.D.	H.P.-S.D.	H.P.-L.D.	X^2 Value	p
Semantic	1	4.60	13.20	6.40	17.80	16.03	<.01
Differential	2	4.40	13.00	6.60	18.00	16.42	<.01
Multdimen.	1	4.40	12.80	6.80	18.00	16.06	<.01
Scaling	2	4.40	12.80	6.80	18.00	16.06	<.01

(The specific lists used are presented in Appendix F.)

After the administration of these various lists a multivariate analysis of variance was undertaken. In this analysis the sums of the scores received by each student across two trials were computed, and the resultant sums for each of the subgroups of PA's served as the multiple criteria.

The results of this analysis are summarized in Table 6. Although the results presented in that table may be conceptualized in a manner analogous to that used with a univariate analysis, the actual parameters needed to describe the multivariate test statistic are different. (If questions concerning these differences exist, the reader should consult the article by Jones, 1966.)

As evident in Table 6, the two different measurement techniques used in deriving the classifications for the different stimuli led to differential rates of learning. In particular, the students learned the lists derived using the scaling procedure better than they did the lists developed via the semantic differential. A more detailed analysis of the means on each of the dependent variables for each of these conditions, (see part of a Table 7) showed that the major cause for this difference was that under the scaling procedure the students learned the large distance, word pairs better than the students who received the large distance, word pairs derived using the semantic differential, independent of polarity level.

The second major effect to reach significance was the list effect. In that instance the results showed that for some reason the first lists to be developed were easier than the second lists. The interpretation of this finding will be delayed until later, when an interpretation of the significant Procedure-List-Treatment interaction is discussed.

Although the test of the Treatment effect was significant, the direction of the observed differences was opposite that which would be predicted from the results obtained by Rohwer (1969). Specifically, in the present study the use of verbal strings was shown to have a deletarious effect upon learning. This effect occurred with each of the subgroups of paired-associates. (These means can be found in part b of Table 7.)

Table 6

The Summary of the Multivariate Analysis of Variance for the Learning Data

Source of Variance	df1	df2	Mult.F Value	p
Measurement Procedure	4	293	4.58	<.001
Lists	4	293	2.29	<.06
Treatments (Sent.vs coin.)	4	293	3.80	<.005
Order	4	293	.37	<.83
Proc. X Lists	4	293	.84	<.50
Proc. X Trts.	4	293	.37	<.83
Proc X Order	4	293	1.29	<.28
Lists X Trts.	4	293	.83	<.51
Lists X Order	4	293	.60	<.67
Trts. X Order	4	293	.20	<.94
Proc. X Lists X Trts.	4	293	2.88	<.02
Proc. X Lists X Order	4	293	.58	<.68
Proc. X Trts X Order	4	293	1.51	<.20
Lists X Trts. X Order	4	293	.87	<.48
Porc X Lists X Trts. X Order	4	293	.10	<.98
Grand Means	4	293	687.16	<.0001

The evaluation of the hypothesis dealing with the interaction between treatment conditions and intra-word pair distances was conducted using the different means generated when testing the treatment hypothesis. Specifically, a simultaneous confidence interval for a contract of the form:

$$\hat{\Psi} = (\bar{x}_{LP-SD,\ SENT.} - \bar{x}_{LP-SD,\ COIN.}) - \cdots\cdots - (\bar{x}_{HP-LD,\ SENT.} - \bar{x}_{HP-LD,\ COIN}),$$

was established. This contract was not significantly different from zero, and as a result the hypothesis of interest could not be rejected. That is, a significant interaction between intra-word pair distance and Treatment was not found.

As was noted earlier, another effect to reach significance in the multivariate analysis of variance was the Procedure-List-Treatment Interaction. Inspection of the different means presented in part c of Table 7,

especially the column denoted as "sums", suggests that for the two lists generated via the semantic differential procedure, the difference between the Sentence and Coincidental conditions was significantly greater for list #2 than for list #1, while for the lists developed via the scaling procedure, the difference between the Sentence and Coincidental conditions was greater for list #1 than for list #2. These results when combined with the observed rejection of the hypothesis involving equality of performance for different lists, would seem to indicate that polarity and inter-point distance are not the only, and perhaps not even the major, determinants of inter-list variations.

The last effect to be tested via the multivariate analysis of variance was the grand mean. Although this particular test is not usually conducted under the univariate analysis of variance model, in the present context the significance of this result demonstrated that the means of each of the dependent variables were not equal to zero. Therefore, comparisons among these means would involve quantities that were essentially, all nonzero.

As in the case of the treatment-word group, interaction hypothesis, the hypotheses related to polarity levels and intra-word pair distance were evaluated via the establishment of simultaneous confidence intervals. (The four means being compared in these intervals were the grand means contained in part d of Table 7.) The two intervals of interest showed that (a) the students under all conditions did better on the word-pairs whose elements were most similar in meaning (i.e., they did better on the low-polarity small distance and high polarity-small distance subgroups than they did on the low-polarity-large distance and high polarity-large distance subgroups), and (b) performance on the two subgroups of high polarity word pairs (i.e., the high polarity-small distance and high-polarity-large

distance pairs) was significantly better than the performance on the two low polarity subgroups. Thus, these two hypotheses were confirmed by the data.

Table 7

The Different Sets of Means Generated in the Learning Study

Groups of Interest							
Part a				LP-SD	LP-LD	HP-SD	HP-LD
Semantic Differential				5.00	4.56	5.85	5.01
Scaling Procedure				5.37	5.08	5.71	5.81
Part b				LP-SD	LP-LD	HP-SD	HP-LD
Sentence Condition				4.83	4.42	5.44	4.92
Coincidential Condition				5.54	5.23	6.12	5.89
Part c			SUMS	LP-SD	LP-LD	HP-SD	HP-LD
Sem. Diff.	List 1	Sent.	21.24	5.44	5.01	5.90	4.90
		Coin.	22.50	5.35	5.01	6.49	5.65
	List 2	Sent.	16.23	3.77	3.41	4.97	4.08
		Coin.	21.68	5.45	4.82	6.03	5.40
Scaling	List 1	Sent.	20.12	4.98	4.70	5.28	5.18
		Coin.	24.87	6.49	5.74	6.23	6.41
	List 2	Sent.	20.87	5.13	4.55	5.63	5.55
		Coin.	22.03	4.89	5.33	5.72	6.10
Part d				LP-SD	LP-LD	HP-SD	HP-LD
Grand Means				5.18	4.82	5.78	5.41

Conclusions

The findings involving the comparison of the semantic relationsips obtained using the two, selected scaling techniques showed that although both procedures produced the same number of semantic dimensions, the specific inter-stimulus structures generated were not very similar. With regard to the notion of polarity the two procedures were shown not to lead to the generation of comparable polarity estimates. Additional results evolving from the cluster analyses of the two structures revealed several ways in which they differed. Seemingly the most salient of these differences was the greater homogeneity of meaning existent in the clusters generated via the scaling technique, i.e., clusters that somewhat resembled the kinds of convergent concepts described by Bruner, et. al. (1956). These findings suggest that such a scaling procedure might lead to the evolvement of a semantic structure that is more consistent with behavioral conceptions of meaning than is the structure generated via the semantic differential. More research in this area, e. g., norming and reliability studies must be undertaken, however, in order to evaluate this hypothesis.

During the learning phase of the study three of the hypothesis of interest were supported. First, the students learned the word-pairs generated via the scaling technique faster than they learned the word-pairs generated using the semantic differential results. One possible explanation for this finding is that the work-pairs generated via the scaling technique contained elements that were more homogeneous relative to their cluster membership than were the work-pairs generated via the semantic differential. Finally, the two hypotheses dealing with polarity and intra-word pair distance showed that performance on high polarity word pairs was

greater than performance on low polarity word pairs, irregardless of intra-word pair distances, and that the small-distance word pairs were learned more rapidly than the large distance word pairs. These results confirmed the findings for children reported by Weber (1968), and suggest that when dealing with intra-word pair distance as an independent variable during learning a researcher must conceptualize that variable as being nested within a polarity level. More specifically, if polarity and intra-word pair distance are to be employed concurrently, then the later variable should be treated as being nested within the former variable.

Although the present investigation was only exploratory in character the results suggest several directions for future research. First, the establishment of normative data for a wider variety of stimulus words using the selected scaling procedure could produce a valuable tool for further research into the effects of semantics on the learning process. More directly, the results suggest that in an instructional setting involving simple messages, learning of the type considered should be improved if the semantic characteristics of the critical elements are properly arranged by the encoder or teacher. Such learning could be particularly valuable in developing and enhancing the semantic structures of deprived children presently being included in Headstart and Title I Programs.

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APPENDIX A

The Ranking Booklet

Instructions:

The purpose of the test you are going to take is to see what meanings different people have for certain words. When taking this test mark your answers in the appropriate spaces on the basis of the similarity of meaning of the different words as you view them. On the top of each page of your booklet you will find a different word and a set of 60 other words below it. You are to rank order these 60 words in terms of their similarity of meaning to the word provided at the top of the page. Note that the word at the top of each page is repeated in the listings. Always assign that word a rank of 00 in your rank ordering.

Here is an example of how you are to rank the words in your booklet. Study this example carefully before proceeding.

Suppose the following represents a page in your booklet, with 30 words in each of two columns. (The dots indicate that 28 words in each column were skipped for this illustrative example.)

Mammal

pear ____ ____ mammal ____ ____

....

....

car ____ ____ dog ____ ____

1. The first thing you should do is mark the word mammal in the list by placing the rank of 00 in the associated spaces as follows:

Mammal 0 0

2. Now, suppose you feel that of the remaining 59 words the one most similar in meaning to mammal is dog. If this is the case, you should mark the spaces after the word dog as follows:

dog 0 1 or dog ____ 1

If you feel the word pear is the most similar in meaning of the remaining 58 words to mammal, you should assign it a rank of 2 by filling in the associated spaces as follows:

pear 0 2 or pear ____ 2

Finally, suppose you feel the word car of all the words presented is most unlike mammal in its meaning, then you should fill in the blank spaces after the word car as follows:

car 5 9

An Example Page

snake	____	____	girl	____	____
respect	____	____	chair	____	____
wealth.	____	____	map	____	____
rain	____	____	need	____	____
dog	____	____	star	____	____
hair	____	____	picture	____	____
woman	____	____	pain	____	____
stone	____	____	crime	____	____
lake	____	____	choice	____	____
bread	____	____	power	____	____
heart	____	____	belief	____	____
story	____	____	laughter	____	____
hope	____	____	peace	____	____
doctor	____	____	fire	____	____
color	____	____	thief	____	____
tongue	____	____	work	____	____
freedom	____	____	cat	____	____
house	____	____	death	____	____
egg	____	____	music	____	____
Wednesday	____	____	river	____	____
future	____	____	window	____	____
friend	____	____	policeman	____	____
sun	____	____	courage	____	____
knowledge	____	____	guilt	____	____
heat	____	____	fear	____	____
horse	____	____	smoke	____	____
man	____	____	hunger	____	____
sympathy	____	____	progress	____	____
fruit	____	____	cup	____	____
head	____	____	marriage	____	____

Important:

1. Be sure the rank you assign to each word is clearly written.

2. Be sure you rank each of the words in the list--do not omit any.

3. Check your rank orderings for each word and be sure you have not assigned the same rank to two or more words.

Please do not look back and forth through your booklet. Rank each word separately, and do not try to remember how you ranked similar words earlier in the test.

APPENDIX B

The Rating Booklet

Instructions:

The purpose of the test you are going to take is to see what meanings different people have for certain words. When taking this test, please mark your answers on the basis of what the words mean to you. On each page of this booklet you will find a different word and a set of 21 rating scales below it, you are to rate each word on each of these scales! Here is how you are to use the scales:

1. If you feel that the word at the top of the page is very closely related to one end of the scale, you should circle the number above the space as follows:

   fair 1 2 3 4 5 6 7 unfair

   or

   fair 1 2 3 4 5 6 7 unfair

2. If you feel that the word is quite closely related to one or the other ends of the scale (but not extremely), you should circle the number or numbers on the scales as follows:

   weak 1 2 3 4 5 6 7 strong

   or

   weak 1 2 3 4 5 6 7 strong

3. If the word is only slightly related to one end of the scale as opposed to the other end (but is not really neutral), then you should circle the appropriate numbers as follows:

   fast 1 2 3 4 5 6 7 slow

   or

   fast 1 2 3 4 5 6 7 slow

4. If you think the word is neutral, or if you feel that a scale is completely unrelated to a word, then you should circle the middle number as follows:

   dangerous 1 2 3 4 5 6 7 safe

Important:

1. Completely circle the numbers you select.
2. Be sure you circle a number for each scale for each word--do not omit any.
3. Circle only one number for each scale for each word.

An Example Page

beautiful	1	2	3	4	5	6	7	ugly
passive	1	2	3	4	5	6	7	active
familiar	1	2	3	4	5	6	7	unfamiliar
vague	1	2	3	4	5	6	7	precise
hard	1	2	3	4	5	6	7	soft
abstract	1	2	3	4	5	6	7	concrete
complex	1	2	3	4	5	6	7	incomplex
dissonant	1	2	3	4	5	6	7	harmonious
animate	1	2	3	4	5	6	7	inanimate
weak	1	2	3	4	5	6	7	strong
intangible	1	2	3	4	5	6	7	tangible
uncommon	1	2	3	4	5	6	7	common
specific	1	2	3	4	5	6	7	general
elementary	1	2	3	4	5	6	7	advanced
tenacious	1	2	3	4	5	6	7	yielding
simplistic	1	2	3	4	5	6	7	intricate
good	1	2	3	4	5	6	7	bad
immobile	1	2	3	4	5	6	7	mobile
known	1	2	3	4	5	6	7	unknown
theoretical	1	2	3	4	5	6	7	applied
particular	1	2	3	4	5	6	7	indefinite

Sometimes you may feel as though you've had the same word before on the test. This will not be the case, so do not look back and forth through your booklet. Rate each word separately, and do not try to remember how you rated other words earlier in the test. Do not worry or puzzle over individual words. On the other hand, do not be careless, since we want to know what each word means to you.

APPENDIX C

Instructions and Examples Used During the Learning Study

Instructions-Sentence Condition:

I am going to show you a series of unrelated sentences. In each one there are two underlined words. You are to learn the word pair in each sentence. I will test you by showing you the left-hand member of each pair and ask you to tell me the right-hand member.

We will start with a practice set of ten sentences. You will see all ten of them, and then there will be a blank frame. The next slide will begin the test trial. You will see one of the left-hand words and should tell me what word went with it. Do you have any question?

Ok, lets start.

(Administer the practice list.)

Now we will begin the actual task. This list contains 20 sentences like the ones you saw in the practice list. Do you have any additional questions?

Ok, lets start.

Instructions-Coincidental Condition:

I am going to show you pairs of words, and you are to learn them. After you have seen all of the pairs. I will show you the left-hand member of each pair and ask you to say the right-hand member.

We will start with a practice set of ten word pairs. You will see all ten word pairs, and then there will be a blank frame. The next slide will begin the test trial. You will see one of the left-hand words and should tell me what word went with it. Do you have any questions?

Ok, lets start.

(Administer the practice list.)

Now we will begin the actual task. This list contains 20 word pairs like the ones you saw in the practice list. Do you have any additional questions?

Ok, lets start.

Examples:

Sentence Condition

1. The Hammer hits a Brick.
2. The Ocean washes the Tree.
3. The Baby wears a Flower
4. A City uses the Truck.
5. The Bruise marks a Table
6. The Worm sees a Light.
7. The Shirt hold the Beans.
8. A Clown fixes a Glass.
9. The Chain scrapes the Arrow.
10. A Piano holds the Slime.

Test Trial

1. Baby - (Flower)
2. Shirt - (Beans)
3. Piano - (Slime)
4. Worm - (Light)
5. Hammer - (Brick)
6. Chain - (Arrow)
7. Clown - (Glass)
8. Bruise - (Table)
9. City - (Truck)
10. Ocean - (Tree)

Coincidental Condition

1. Hammer - Brick
2. Ocean - Tree
3. Baby - Flower
4. City - Truck
5. Bruise - Table
6. Worm - Light
7. Shirt - Beans
8. Clown - Glass
9. Chain - Arrow
10. Piano - Slime

Test Trial

1. Baby - (Flower)
2. Shirt - (Beans)
3. Piano - (Slime)
4. Worm - (Light)
5. Hammer - (Brick)
6. Chain - (Arrow)
7. Clown - (Glass)
8. Bruise - (Table)
9. City - (Truck)
10. Ocean - (Tree)

APPENDIX D

The Rotated Factor Matrix for the Semantic Differential and the Derived Factor Names

Rotatated Factor Matrix: (Loading less than .30 are omitted for simplicity of interpretation.)

Scales	Factors I	II	III	IV	V	VI	VII
1. Beautiful - Ugly							.80
2. Passive - Active		.31	.30		-.31	.44	
3. Familiar - Unfamiliar	.73						.32
4. Vague - Precise		.66					
5. Hard - Soft				-.65			
6. Abstract - Concrete		.69					
7. Complex - Incomplex		.35					
8. Dissonant - Harmonious				-.58			-.46
9. Animate - Inanimate						-.76	
10. Weak - Strong		.47	.31				-.40
11. Intangible - Tangible		.58					
12. Uncommon - Common	-.68	.36					
13. Specific - General					-.74		
14. Elementary - Advanced			.78				
15. Tenacious - Yielding				-.75			
16. Simplistic - Intricate			.81				
17. Good - Bad							.81
18. Immobile - Mobile						.60	
19. Known - Unknown	.73						
20. Theoretical - Applied		.59					
21. Particular - Indefinite					-.74		

APPENDIX D (cont'd)

Factor Names:

Factor	Name	% of Variance Accounted For
I	Familiarity	8.93
II	Concreteness	11.49
III	Complexity	8.28
IV	Potency	7.74
V	Specificity	7.67
VI	Activity	6.41
VII	Evaluative	9.56

APPENDIX E

Polarity Estimates for the 60 Stimuli

Stimulus	SD Approach	Ranking Approach	Stimulus	SD Approach	Ranking Approach
1. peace	5.23	2.45	31. window	2.48	2.70
2. future	4.92	2.08	32. head	2.47	2.17
3. cup	4.88	2.66	33. hair	.246	2.20
4. map	4.64	2.84	34. house	2.45	2.66
5. bread	4.24	2.69	35. egg	2.45	2.68
6. power	4.12	2.53	36. policeman	2.33	2.42
7. chair	3.77	2.94	37. death	2.32	2.69
8. girl	3.73	2.18	38. tongue	2.31	2.72
9. stone	3.70	2.84	39. guilt	2.29	2.64
10. fruit	3.53	2.77	40. fear	2.25	2.56
11. heart	3.44	2.32	41. marriage	2.23	2.46
12. courage	3.43	2.37	42. cat	2.19	2.17
13. freedom	3.14	2.32	43. hunger	2.17	2.47
14. man	3.12	1.81	44. river	2.16	2.66
15. wealth	3.04	2.33	45. star	2.14	2.44
16. snake	3.00	2.62	46. friend	2.12	2.22
17. laughter	[illegible]	2.60	47. lake	2.12	2.58
18. knowledge	2.89	2.26	48. progress	2.11	2.23
19. pain	2.88	2.50	49. hope	2.09	2.27
20. doctor	2.76	1.81	50. heat	1.96	2.68
21. horse	2.76	2.31	51. rain	1.90	2.50
22. wednesday	2.70	1.57	52. respect	1.87	2.36
23. crime	2.68	2.60	53. color	1.76	2.13
24. dog	2.67	2.58	54. picture	1.68	2.26
25. woman	2.66	1.99	55. music	1.61	2.73
26. belief	2.65	2.51	56. story	1.61	2.50
27. smoke	2.61	2.86	57. sun	1.60	2.49
28. thief	2.60	2.50	58. choice	1.53	2.43
29. sympathy	2.59	2.49	59. work	1.44	2.07
30. fire	2.58	2.73	60. need	.95	1.75

APPENDIX F

Lists Derived Using the Semantic Differential

L.P.-S.D.

1. River - Work
2. Policeman - Heat
3. Egg - Window
4. Color - Lake
5. Fear - Hunger

L.P.- S.D.

1. House - Music
2. Head - Sun
3. Policeman - River
4. Marriage - Lake
5. Need - Progress

L.P. - S.D.

1. Hope - Tongue
2. Hair - Guilt
3. Star - Friend
4. Cat - House
5. Rain - Progress

L.P. - S.D.

1. Egg - Fear
2. Cat - Guilt
3. Work - Hope
4. Death - Tongue
5. Window - Friend

L.P. - S.D.

1. Peace - Future
2. Fruit - Cup
3. Wednesday - Bread
4. Smoke - Thief
5. Crime - Rain

L.P. - S.D.

1. Cup - Bread
2. Sympathy - Woman
3. Man - Crime
4. Fire - Snake
5. Knowledge - Belief

L.P. - S.D.

1. Knowledge - Stone
2. Girl - Power
3. Dog - Courage
4. Fire - Map
5. Snake - Freedom

L.P. - S.D.

1. Doctor - Smoke
2. Rain - Future
3. Heart - Chair
4. Fruit - Peace
5. Stone - Freedom

Lists Derived Using the Scaling Procedure:

L.P. - S.D.

1. Cat - House
2. Need - Work
3. Policeman - Knowledge
4. Heart - Sympathy
5. Freedom - Respect

L.P. - S.D.

1. Man - Head
2. Respect - Courage
3. Marriage - Hope
4. Wealth - Future
5. Hunger - Need

L.P. - S.D.

1. Hair - Future
2. Wealth - Star
3. Picture - Hope
4. Woman - Hunger
5. Peace - Wednesday

L.P. - S.D.

1. Picture - Sympathy
2. Cat - Knowledge
3. Friend - Words
4. Choice - Doctor
5. Horse - Progress

L.P. - S.D.

1. Power - Death
2. Fruit - Egg
3. Fire - Sun
4. Tongue - Snake
5. Cup - House

L.P. - S.D.

1. House - Bread
2. Guilt - Fear
3. Power - Map
4. Sun - Lake
5. Tongue - Dog

L.P. - S.D.

1. Window - Belief
2. Thief - Laughter
3. Map - Rain
4. Dog - Smoke
5. River - Chair

L.P. - S.D.

1. Snake - Music
2. Stone - Belief
3. Laughter - Crime
4. River - Smoke
5. Thief - Cup